VARIATIONS IN POLARIMETRIC BACKSCATTER OF SALINE ICE GROWN UNDER DIURNAL THERMAL CYCLING CONDITION

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An experiment was carried out in January 1994 at the Geophysical Research Facility in the Cold Regions Research and Engineering Laboratory. To investigate effects on polarimetric scattering signatures of sea ice growth under diurnal temperature variations, an ice sheet was grown for 2.5 days for the thickness of 10 cm and a polarimetric radar operating at C band was used to obtain backscattering data in conjunction with ice-characterization measurements.

The ice sheet was grown in the late morning of January 19, 1994. The initial growth rate was slow due to high insolation] and temperature. As the air temperature dropped during the night, the growth rate increased significantly. The air temperature changed drastically from about --1 0°C to -- 35° C between clay and night. The temperature cycle was repeated during the next day and the growth rate varied in the same manner. The surface of the ice was partially covered by frost flowers and the areal coverage increased as the ice became thicker.

Throughout the ice growth duration of 2.5 days, polarimetric backscatter data were collected at roughly every centimeter of ice growth. For each set of radar measurements of saline ice, a set of calibration measurements was carried out with trihedral corner reflectors and a metallic sphere. Measured polarimetric backscattering coefficients of the ice sheet reveal a strong correlation between radar data and temperature variations. As the temperature increased (decreased), the backscatter increased (decreased) correspondingly. From the ice-characterization data, temperatures of the air, at the ice-air interface, and in the ice layer had the same variation trend. Another interesting experimental observation is that the salinity measured as a function of ice depth from a sample of 10-cm thick ice indicated that the salinity variations had a similar cycle as the temperatures; i.e., the salinity profile recorded the history of the temperature variations. Characterization data of the ice sheet are used in a theoretical model for scattering from saline ice with frost cover to explain the observed polarimetric signatures.